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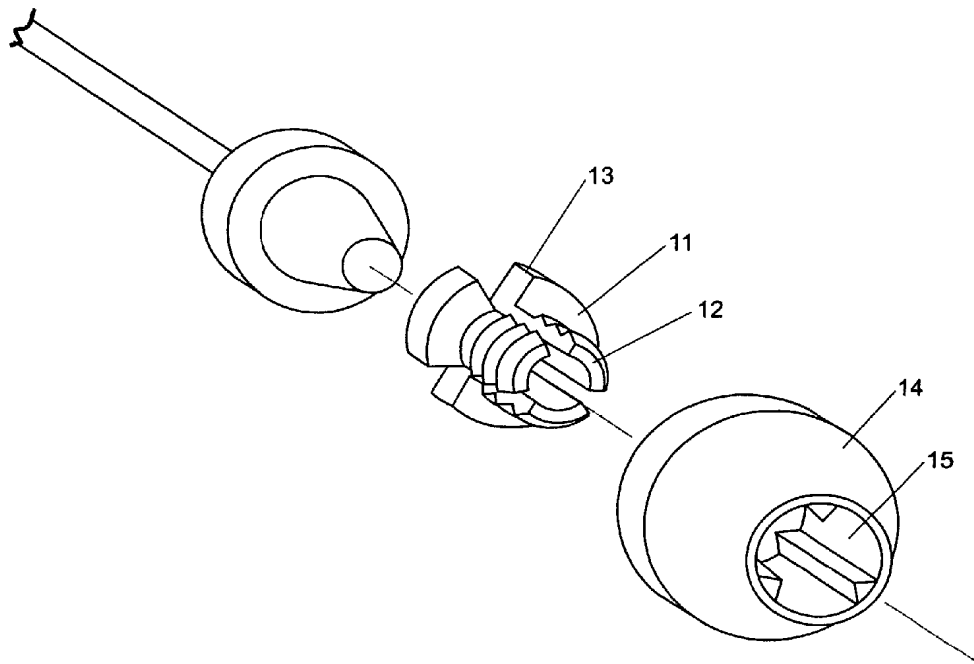
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(54) Title: SURGICAL IMPACTOR WITH WORKPIECE ENGAGEABLE HEAD



(57) Abstract: A surgical impactor has a surgical implant engagement end with a threaded collet, adjusted between relaxed and withdrawal modes using controls at the surgeon end of the impactor. The collet (11) has threaded fingers (12) and a collar (14) with keyways (15) for each finger. The fingers of the collet engage an implant when relaxed and allow the implant to be released when in withdrawal mode.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

SURGICAL IMPACTOR WITH WORKPIECE ENGAGEABLE HEAD

TECHNICAL FIELD

5 The present invention relates to tools and appliances for attachment to an item having an opening, hole, passageway, recess or the like therein.

There are many instances where it is desirable to engage an item yet to provide for a capability of release from that item without a need for the tool or appliance to be rotated about its general axis.

10 One perceived need for such a tool or appliance is in the area of locating items to be implanted during minimally invasive surgery. A particular application, although not one to which the invention is necessarily restricted, is in total hip replacement.

15 In total hip replacement minimum invasive techniques used with clinically proven implants are stated as resulting in shorter recovery times, smaller scales and shorter hospital stays. It is primarily only the instruments used and the surgical procedures adopted that need modification if surgeons are to use a minimum invasive approach.

BACKGROUND ART

20 In its preferred form the present invention therefore is directed to an appliance or tool useful in total hip arthroplasty. More generally however the appliance or tool or apparatus in accordance with the present invention has a wider application and other uses will become apparent from the description hereinafter provided.

SUMMARY OF THE INVENTION

25 Accordingly it is an object of the present invention to provide apparatus capable of meeting at least in part the abovementioned object or at least to provide the public with a useful choice. The invention also relates to related combinations, assemblies, uses and methodologies.

30 In a first aspect the present invention consists in **a surgical impactor** having a surgical implant engagement end and a surgeon's manipulation end *characterised in that* a collet at the engagement end can be caused to collapse or relax, or be allowed to collapse or relax, to a withdrawal mode by use of a control from the surgeon's manipulation end thereby to allow its withdrawal from within a surgical implant previously engaged or engageable thereby in its uncollapsed or less relaxed mode.

Preferably the collet in its uncollapsed or less relaxed mode defines a male thread in a segmented form.

In a further aspect the present invention consists in a **surgical impactor** having a surgical implant engagement end and a surgeon's manipulation end,

characterised in that a collet at the engagement end in a splayed form defines a segmented male thread adapted to screw engage a female thread of an appropriate surgical implant,

and further characterised in that the collet in a less splayed form will allow axial withdrawal of the collet from within the female thread without unscrewing,

and still further characterised in that the surgeon's manipulation end includes a control for causing or allowing the collet to change to its less splayed.

Preferably the impactor has its surgeon's manipulation end adapted to be struck so as to transmit force down an at least in part curved shank.

In another aspect the invention consists in an **apparatus** having an assembly to define a confine,

an array of fingers at least in part emergent from the confine yet captive at least in part in the confine, and

a cam capable of assuming two modes relative to the confine and the array and being actuable to at least one of the two modes whereby

- i) in one mode ("mode (i)"), the cam forces the array to a condition where at least the distal regions of each finger of the array outside of the confine splay outwardly relative to the others, and
- ii) in the other mode ("mode (ii)"), the cam allows the fingers that have been or would be splayed in the (i) mode to reassume or remain in a less mutually splayed outwardly condition.

Preferably each finger is provided with a segment of a screw thread and, in the splayed outwardly condition, the segments co-act as a segmented male thread capable of engaging a complementary female thread and, in the less splayed condition, of allowing the extraction of the finger defined thread segments from within that female thread without threadwise rotation.

Alternatively the threads can act as retention lips or instead be non helical lips.

Preferably the sleeve like member (whether circular or otherwise tubular) at one end defines the array of fingers.

Preferably the sleeve like member with its fingers assumes the mode (ii) referred to previously when not under the action of the cam to splay the same outwardly from a relaxed or more related condition.

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Preferably the cam is movable axially within the sleeve like member from the axial end thereof remote from the distal end of the fingers.

In other forms of the present invention each segmented finger can instead (e.g. instead of the skeletal thread) be provided with means to grip ridge, retention shoulders or the like of a threaded or non threaded bore, passageway, hole, recess or the like.

Preferably means is provided whereby the cam is actuatable to mode (i) against a resilient bias to mode (ii).

In other forms however there is no bias and the cam is actuatable both to the mode (i) and from there to mode (ii) and vice versa.

In some forms of the present invention individual finger possessing elements in the nature of collets or collect segments (as opposed to a unitary collet i.e. the sleeve like member with fingers) are arrayed about an axis and the fingers distally extend outwardly substantially parallel to that axis from an outwardly (i.e. radially outwardly) extending region of each collect or collect segment capable of being held captive within the confine (excepts when dismantled) irrespective of the condition of the cam with respect to modes (i) or modes (ii) and conditions therebetween.

Preferably where individual collets or collet segments are provided, preferably the assembly to define the confine includes a guide for holding the array radially spaced about said axis yet still enabling at least a significant part of each finger captive by but emergent from the confine to extend into the open sufficient to act, if a threaded segment, with like or similar thread segments so as to screw engage an appropriate screw member.

Preferably the apparatus is a tool.

Preferably the apparatus includes an operator actuatable end remote from the assembly, array and cam whereby it is possible to both control the mode of the cam and thus the fingers and also to manipulate the apparatus as a whole or at least the "head" thereof which is defined at least by said assembly, said array and said cam.

In another aspect the present invention is a tool having an item engaging end and an operator manipulation end,

wherein the item manipulation end has a single piece or multi piece captive yet emergent collet array of segmented regions (hereafter "collet(s)") capable of being configured between an in part inwardly disposed form not adapted to effectively engage an intended item and a more outwardly disposed condition adapted to engage an intended item

and wherein the change in disposition between the conditions referred to is capable of being effected from the manipulation end of the tool by means of a movement one way or the other, or both, of a camming member.

Preferably the camming member is a frustoconical member.

5 Preferably the movement of the frustoconical member is achievable by movement of a connecting member that reaches the manipulation end or adjacent thereto from the work piece engagement end or adjacent thereto via a passageway.

Preferably the camming member is biased to its condition which moves the collet array or segmented regions ("collets") to the intended work piece engaging condition.

10 Preferably the collet(s) is confined in an engagement end assembly which prevents rotation of the collet(s) about the axis of the passageway at or adjacent the work piece engagement end.

Preferably the collet(s) are held captive in a chamber of the passageway at least partially closed by a capping collar for the collet(s).

15 Preferably the capping collar is releasably retained by a retention biased release.

In the preferred form of the present invention a single piece collet is provided but which includes separations from what is otherwise its unitary form to allow in the nature of a number of fingers several collet segments to move between the conditions referred to, a relaxed condition of the collet(s) being that not intended to engage an intended work piece.

20 Preferably it is against that relaxed condition that the camming member acts to have the collet(s) assume the intended work piece engagement conditions.

Preferably the camming member is actuable from the manipulation end via a cable.

Preferably the collet(s) is adapted to engage a female thread by one or both

- 25 (i) within the female thread of a work piece, having the collet(s) assume the tool engaging disposition, or,
- (ii) when the collet(s) have been canned into the more outwardly disposed condition, screw engaging the skeletal male thread of tool with the work piece.

30 Preferably the apparatus is a surgical apparatus and the manipulator is a surgeon or an assistant to a surgeon and the intended work piece is apparatus for working on and/or implantation in a mammal.

In one preferred form of the present invention the tool is an impactor for total hip arthroplasty.

In still a further aspect the present invention consists in **an impactor** useful as a tool in total hip arthroplasty which has a male threaded or other appropriately configured collet or

collet like end adapted for engagement of a cup for such total hip arthroplasty from which it can be removed by a collapsing of the collet or collet like end from within the cup (or at least the engaged hole, passageway, opening, recess or the like thereof) by operator input into the tool remote from the cup engageable end.

5 In yet a further aspect the present invention consists in a **minimally invasive surgical procedure** which involves the use of apparatus in accordance with the present invention.

In yet a further aspect the present invention consists in a **method of performing a minimally invasive total hip arthroplasty** which involves the operative use of an appliance or tool in accordance with the present invention for the purpose of cup manipulation within the
10 body of a patient and the release of the cup once appropriately located in the body of the patient.

In still a further aspect the present invention consists in, **in combination, apparatus** (i.e. an appliance or tool) of the present invention and a **work piece** (such as the cup for a total hip arthroplasty or other implant device) having a complementary recess, opening, passageway,
15 hole, female thread, or the like for the apparatus.

In still a further aspect the present invention consists in **the use of apparatus** in accordance with the present invention where there is a screw engagement between an item or work piece and the appliance or tool and subsequently there is a release of the item or work piece from the appliance or tool without a counter rotation to the screw thread engagement
20 rotation (irrespective of whether or not such screwing was used for the engagement).

As used herein the term “and/or” means “and” or “or” or both as the circumstances might allow.

As used herein the term “(s)” following a noun includes either or both the plural and singular forms of that noun.

25 Reference herein to a “surgeon” or “surgeon’s” includes within its ambit any person assisting a surgeon or assisting in surgery.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred forms of the present invention will now be described with reference to the
30 accompany drawings in which:

Figure 1 shows a partial view of the pelvis and the acetabular component (i.e. the cup) to be located therein after appropriate preparation of the pelvis for the component, such component generally having centrally of its substantially hemispherical form a female threaded opening to which the impactor (the appliance or tool) is to engage from the concave side,

Figures 2A and 2B are a simple side elevation of an elongate impactor having at the right hand end a head in accordance with the apparatus of the present invention, an elongate shank which includes a passageway to allow actuation of the cam at the head end, and the surgeon or operator end which enables manipulation of the whole appliance and the control of the transition of the cam between the modes, the shank preferably having a curve at a convenient region that lends itself to minim hip surgery through one of two insertions to be made in the tissue of a patient having a total hip arthroplasty, figure 2A showing a lever action control for the cam (the release condition being shown by the broken lines) and figure 2B showing a screw action control (e.g. through a rod, cable or the like) for the cam,

Figure 3 shows an exploded view of a single piece collet or collet forming sleeve of the present invention and a cable actuatable (axially moveable) frustoconical cam,

Figure 4 is a view from the other end of the collet of Figure 3,

Figure 5 is an exploded view of a less preferred variant of the arrangement of Figure 3 showing a modified form of cable actuated cam, multiple thread providing segments (each a collet in its own right) which co-act to form an overall skeletal thread forming collet to be held captive by the confine (not fully shown) reliant upon an end cap or collar shown in Figure 5 which includes anti-rotational characteristics for each collet or collet segment so as to keep the array (in this case only three segments) circumferentially spaced during use between modes 1 and 2 and at those modes,

Figure 6 shows in a sectional diagrammatic form a cam as shown in Figure 5 outwardly splaying a single or multiple piece collar within an end cap forming type collar as shown in Figure 5, the collar being shown axially located by a leaf spring loaded lever capable of being pressed to the left to allow its release, such a lever as shown in Figure 6 having an anti-rotational characteristic,

Figure 7 is a view from below of the apparatus as shown in Figure 6,

Figure 8 is a similar view to that of Figure 6 but showing a more preferred unitary form of collar such as disclosed in Figure 3 and 4, the other aspects being substantially as depicted in Figures 5 and 6,

Figure 9 is the view from below of the apparatus in Figure 8,

Figure 10 shows another embodiment, this embodiment being of an impactor suitable for use in performing a minimally invasive total hip arthroplasty, the impactor being shown in its condition as it is where its collet fingers screw engage into a complementary female thread of the implant cup (not shown),

Figure 11 is a similar view to that of **Figure 10** but showing the release of an arm which will have the effect of withdrawing the cam of the actuator thereby allowing the fingers of the collet sleeve to assume a more relaxed condition,

Figure 12 shows a moulding capable of providing the shank of the impactor tool depicted in **Figures 10** and **11**, there being a passageway within which the cam carrying actuator is longitudinally moveable,

Figure 13 shows the actuator suitable for inclusion in the moulding of **Figure 12**, the actuator having at the bottom left end an appropriate cam for the collet sleeve to be hereafter described,

Figure 14 shows an impactor head piece for engagement as shown in **Figures 10** and **11** which will allow striking of the implement as may be required and which, if appropriately indexed into the overall assembly, will allow some measure of rotational control of the overall apparatus,

Figure 15 shows the lever of the assembly of **Figures 10** and **11**,

Figure 16 is the push button release that is used in conjunction with the uplifting of the lever between the conditions shown in **Figures 10** and **11** to enable release of the cup by axial withdrawal of the collet fingers of the impactor from within the female thread of the cup,

Figure 17 shows the sleeve (skeletal though it may be) that defines the fingers of the collet,

Figure 17A shows in outline drawing, as opposed to the SOLIDWORKS™ format of **Figure 17**, the component of **Figure 17**,

Figure 18 shows the preferred confinement member or external collet guide for in part locating and confining the collet sleeve,

Figure 18A in a manner similar to **Figure 17A** better shows the component,

Figure 19 shows a lock ring to lock over and hold inwardly in an engaged condition the flexible arms shown in the external collet guide member of **Figures 18** and **18A**, and

Figure 19A shows an outline of the component shown in **Figure 19**.

DETAILED DESCRIPTION OF THE INVENTION

In the preferred form of the present invention there is at the head end of the appliance or tool. Held captive in a chamber at the head end of the shank of the appliance is the cam or pin 1 controlled as to axial movement by a cable 2 or other means of connection.

The collet forming sleeve 3 has a plurality (in this case four) fingers 4 disposed about its sleeve like axis. The greater preferably cylindrical tubular region 5 of the collet region 5 is

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preferably separated or machined [e.g. wire cut or otherwise separated (alternatively even by moulding procedures)] at 6 so as to maximise the degree of resilient flexure possible between the proximal end 7 and the distal end 8 for each collet segment or finger 4.

As shown the segments 4 preferably define a screw thread 9 capable of engaging into the female threaded cup of the component as shown in Figure 1.

Anti-rotation features for seating on an appropriate indexing projection of a seat or the like in the confinement chamber is provided at 10.

The alternative to such an arrangement is a more complex and more difficult to disassemble and reassemble construction that includes individual collets or collet components 11 which each defines a finger 12 and a region 13 of greater outward extent at the proximal end thereof for the purpose of location as described later.

Whilst the collar or end cap 14 includes locating keyways or the like 15 for each segment 11, some additional means of location of the array may be warranted.

In the embodiment shown in Figures 6-9 a lever (preferably one of two) acts about a pivot axis 16. This lever 17 is biased by a leaf spring 18 to the condition shown so that an extension 19 of the lever both axially locks the collar 20 and rotationally locks the collar 20 (see Figures 6 and 7 respectively). A similar arrangement exists in the embodiment of Figures 8 and 9.

The arrangement as shown in Figures 6 and 7 shows the frustoconical cam 21 holding outwardly (against inward collapse but whilst still captive) the collet segments 22 which are located against removal by the expanded regions 23. Axial spacing of the collets 22 is assisted by collet guides 24.

The top of the frustoconical form 21 i.e. the expanded region 25 seats a bellows or other appropriate springing arrangement 26 (e.g. helical spring, etc.) which biases the cam 21, 25 to the condition shown in Figure 6. The cable 27 actuatable by means at the operator end is capable of being pulled against the bias of the members 26 so as to allow the release of the fingers 22 inwardly so that they pull clear of the cup or other form with which they interengage whether by a screw form or not.

The arrangement in Figures 8 and 9 is to be preferred as it provides less in the way of difficulty insofar as assembly and disassembly is concerned for cleaning purposes i.e. there is not the prospect of the individual collet segments being lost, instead here there is a single sleeve like member 28 with its individual resilient segments 29 each of which acts as a finger.

A person skilled in the art will appreciate how apparatus in accordance with the present invention can be varied yet still achieve the outcome desired. A person skilled in the art will

appreciate any form of control at the top for the cam or the tapered pin can be utilised. A person skilled in the art will also appreciate that any type of bias if a bias at all is required can be used. Instead, the means of actuation can be (whether a cable, pin or other means, including even helical drive or the like means) can be utilised to control the deployment.

5 Preferably all components to the extent required can be manufactured from a medically acceptable metal such as stainless steel, titanium or the like although if desired certain of the components can be moulded from a compatible material (ceramic, plastics or otherwise).

A preferred form of the present invention is the impactor tool for minimum invasive total hip arthroplasty which includes the components depicted and the assemblies depicted in Figures 10 10 onwards.

As can be seen in Figure 10 and 11 the impactor is capable of being impacted or manipulated from its right hand end.

The outwardly splayed collet fingers carrying their segmented thread 30 will assume not an inward relaxation, which would allow disengagement without rotation from the implant cup, 15 unless there is both actuation of the push button 31 and the swinging out to the condition shown in Figure 11 of the arm 32. This will ensure that *in vivo* there is no accidental release of the cup prior to the surgeon being satisfied that it is being properly impacted in place.

The shank of the impactor 33 is that component shown in Figure 12 within which the actuator member 34 is located and can move sufficiently longitudinally (here the term 20 "longitudinally" is being used loosely owing the arcuate nature of the shank member 13 and the corresponding conformation of the actuator 34) so that the camming end region 35 of the actuator 34 either splays outwardly the fingers 30 or, by being moved back more towards the manipulation end, allows the relaxation of the fingers inwardly.

The moulding 33 includes a mounting protuberance as shown for, for example, light 25 mounting.

The preferred form of the collet sleeve is as shown in Figures 17 and 17A. The fingers 30 each extends from a flexible part of the surround 36. Optionally located as an integral inwardly extension of the moulding is an array capable of acting as an inner guide in which the cam region 35 of the actuator can move to and from an outward splaying condition i.e.; back to 30 a less splaying condition which allows relaxation of the fingers 30.

Surrounding the member shown in Figures 17 and 17A is the external collect guide member 18 and 18A which has flexible members 37 having the ends 38 thereof adapted to be pressed inwardly by the locking ring 39 so as to engage the retention regions 38 into the retention groove 39 of the member 33 shown in Figure 12.

The action of assembly is:

- Placing the lock ring of Figures 19 and 19A on the collet guide of Figures 18 and 18A.
- Then place the collet of Figures 17 and 17A in the main body, ie; the moulding of Figure 12.
- Place the collet guide and ring assembly over the collet in the body.
- Push down the retainer (ie; 37 and 28) via the ring 39 and rotate clockwise which in turn retains the collet and overcomes the effect of inertia associated with beating the instrument with a hammer.

There is also a feature in this assembly which allows indexing. This is the association between the small knob on the actuator and the radial recesses in the collet retainer. When engaged the rotation is controlled. When removed the collet guide assembly can be rotated.

CLAIMS:

1. **A surgical impactor** having a surgical implant engagement end and a surgeon's manipulation end and characterised in that a collet at the engagement end can be caused to or be allowed to collapse or relax to a withdrawal mode by use of a control from the surgeon's manipulation end thereby to allow its withdrawal from within a surgical implant previously engaged or engageable thereby in its uncollapsed or less related mode.

2. An impactor of claim 1 wherein the collet in its uncollapsed or less relaxed mode defines a male thread in a segmented form.

3. **A surgical impactor** having a surgical implant engagement end and a surgeon's manipulation end

characterised in that a collet at the engagement end in a splayed form defines a segmented male thread adapted to screw engage a female thread of an appropriate surgical implant

and further characterised in that the collet in a less splayed form will allow axial withdrawal of the collet from within the female thread without unscrewing

and still further characterised in that the surgeon's manipulation end includes a control for causing or allowing the collet to change to its less spalyed.

4. An impactor of any one of the preceding claims wherein the impactor has its surgeon's manipulation end adapted to be struck so as to transmit force down an at least in part curved shank.

5. An impactor of any one of the preceding claims wherein a cam is movable by said control.

6. **An impactor** useful as a tool in total hip arthroplasty which has a male threaded or other appropriately configured collet or collet like end adapted for engagement of a cup for such total hip arthroplasty from which it can be removed by at least a partial collapsing or relaxation of the collet or collet like end from within an engaged hole, passageway, opening, recess or the like of the cup by operator input into the tool remote from the cup engageable end.

7. **Apparatus** having

an assembly to define a confine,

an array of fingers at least in part emergent from the confine yet captive at least in part in the confine, and

a cam capable of assuming two modes relative to the confine and the array and being actuable to at least one of the two modes whereby

i) in one mode ("mode (i)"), the cam forces the array to a condition where at least the

distal regions of each finger of the array outside of the confine splayed outwardly relative to the others, and

- ii) in the other mode ("mode (ii)"), the cam allows the fingers that have been or would be splayed in the (i) mode to reassume or remain in a less mutually splayed outwardly condition.

8. Apparatus of claim 7 wherein each finger is provided with a segment of a screw thread and, in the splayed outwardly condition, the segments co-act as a segmented male thread capable of engaging a complementary female thread and, in the less splayed condition, of allowing the extraction of the finger defined thread segments from within that female thread without threadwise rotation.

9. Apparatus of claim 7 or 8 wherein a sleeve like member (whether circular or otherwise tubular) at one defines the array of fingers.

10. Apparatus of claim 9 wherein the sleeve like member with its fingers assumes the mode (ii) when not under the action of the cam to splay the same outwardly from a relaxed or more relaxed condition.

11. Apparatus of claim 10 wherein the cam is movable axially within the sleeve like member from the axial end thereof remote from the distal end of the fingers.

12. Apparatus of any one of claims 7 to 11 which includes an operator actuatable end remote from the assembly, array and cam whereby it is possible to both control the mode of the cam and thus the fingers and also to manipulate the apparatus as a whole or at least the "head" thereof which is defined at least by said assembly, said array and said cam.

13. A tool having an item engaging end and an operator manipulation end, wherein the item manipulation end has a single piece or multi piece captive yet emergent collet array of segmented regions (hereafter "collet(s)") capable of being configured between an in part inwardly disposed form not adapted to effectively engage an intended item and a more outwardly disposed condition adapted to engage an intended item,

and wherein the change in disposition between the conditions referred to is capable of being effected from the manipulation end of the tool by means of a movement one way or the other, or both, of a camming member.

14. Apparatus of claim 13 which is a surgical apparatus and the manipulator is to be a surgeon or an assistant to a surgeon and the intended work piece is apparatus for working on and/or implantation in a mammal.

15. Apparatus of claim 14 wherein the tool is an impactor for total hip arthroplasty.

16. In combination, a surgical impactor or apparatus of any one of the preceding claims and a surgical implant engageable by the engagement end thereof.

17. **A minimally invasive surgical procedure** which involves the use of apparatus in accordance any one of the preceding claims.

5 18. **A method of performing a minimally invasive total hip arthroplasty** which involves the operative use of an appliance or tool in accordance with any one of claims 1 to 15 for the purpose of cup manipulation within the body of a patient and the release of the cup once appropriately located in the body of the patient.

10 19. **In combination, apparatus of any one of claims 1 to 15** and an item (such as the cup for a total hip arthroplasty or other implant device) having a complementary recess, opening, passageway, hole, female thread, or the like for engagement with and subsequent release from the apparatus.

15 20. **The use of apparatus** in accordance with any one of claims 1 to 15 where there is to be or is a screw engagement between an item and the apparatus and subsequently there is to be or is a release of the item from the apparatus without a screw thread type rotational disengagement (irrespective of whether or not such screwing was used for the engagement).

20 21. In a surgical procedure, the use of an impactor capable of an outward collet engagement (whether screw engaged or not) of the implant cup and capable of disengagement of the implant cup *in vivo* by use of a manipulation end input which allows or causes inward collet movement thereby to release the implanted cup.

22. Apparatus substantially as hereindescribed with reference to any one, some or all of the accompanying drawings.

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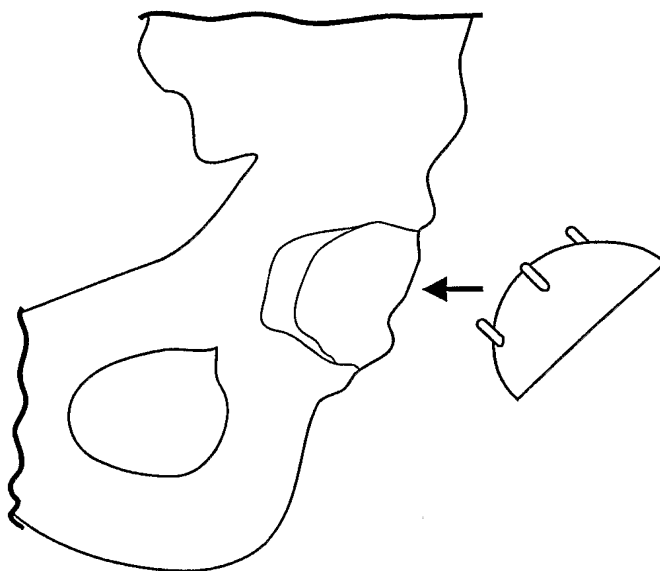


FIGURE 1

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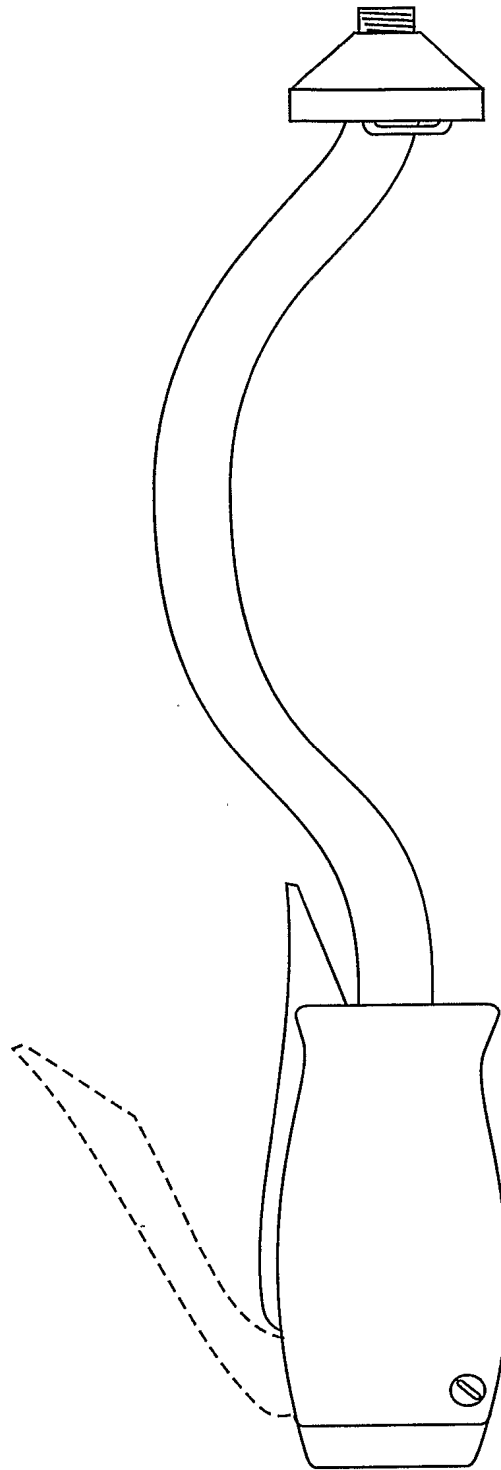


FIGURE 2A

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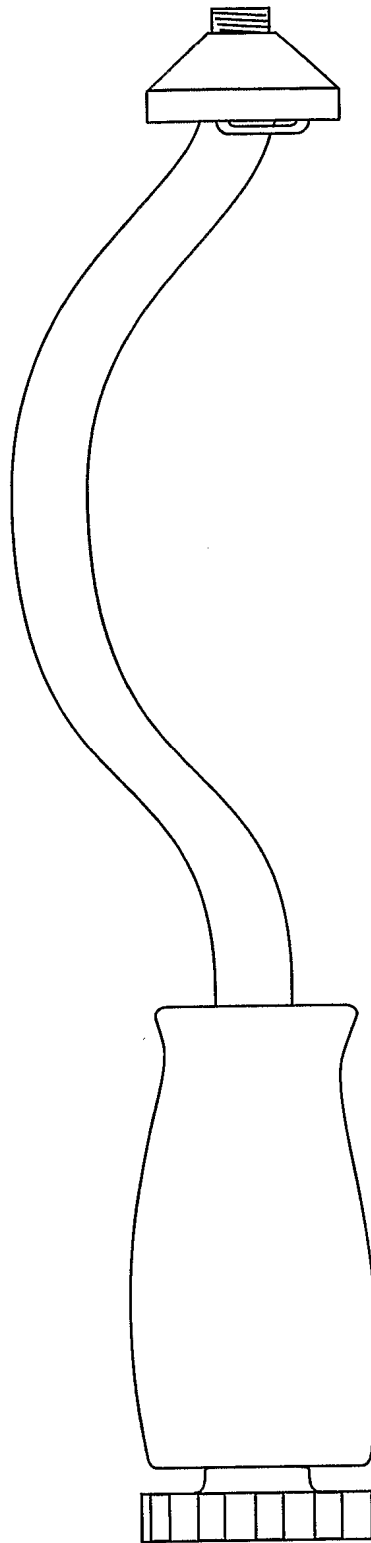
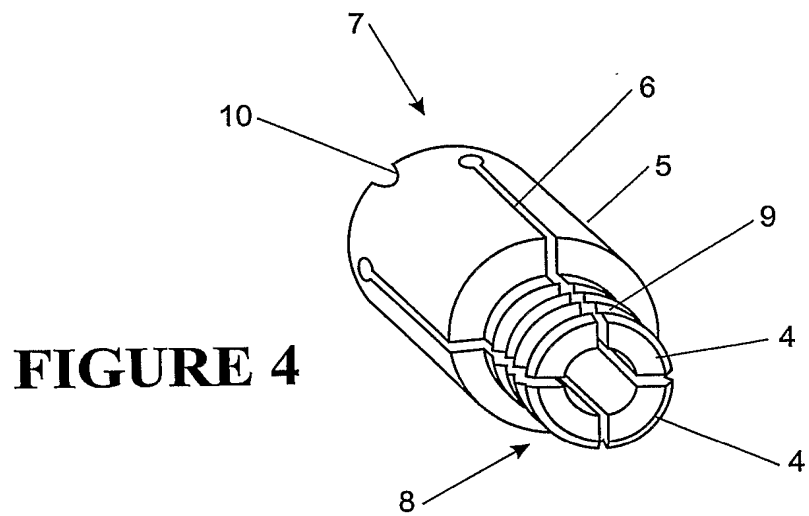
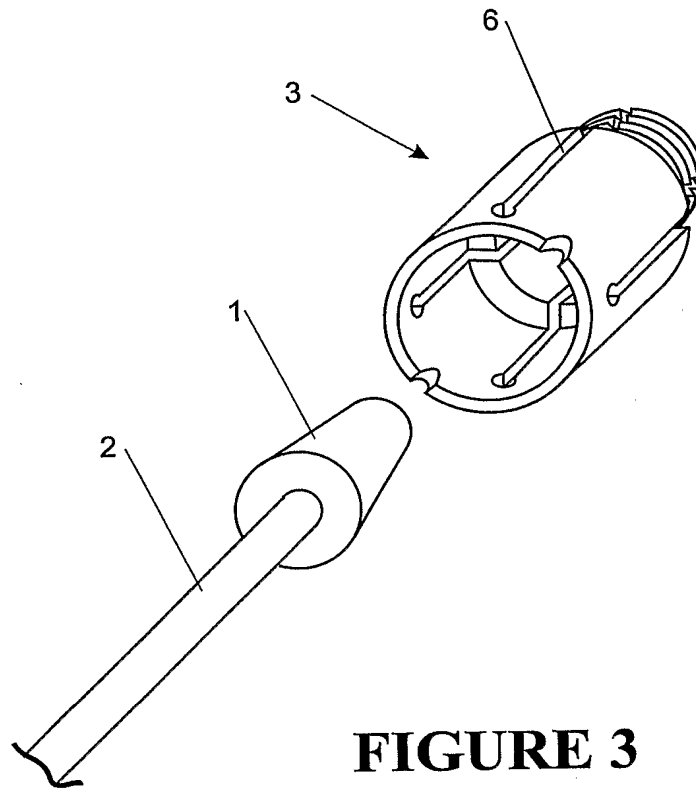


FIGURE 2B

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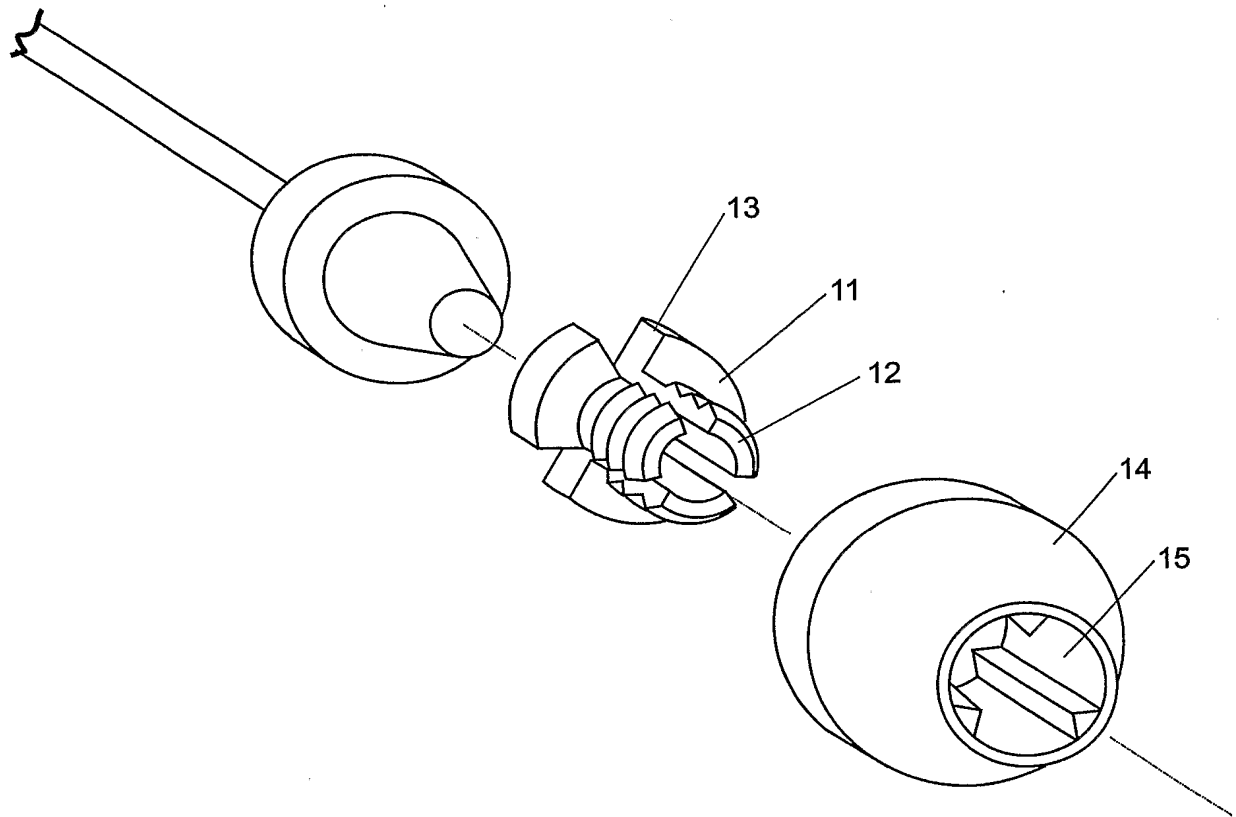


FIGURE 5

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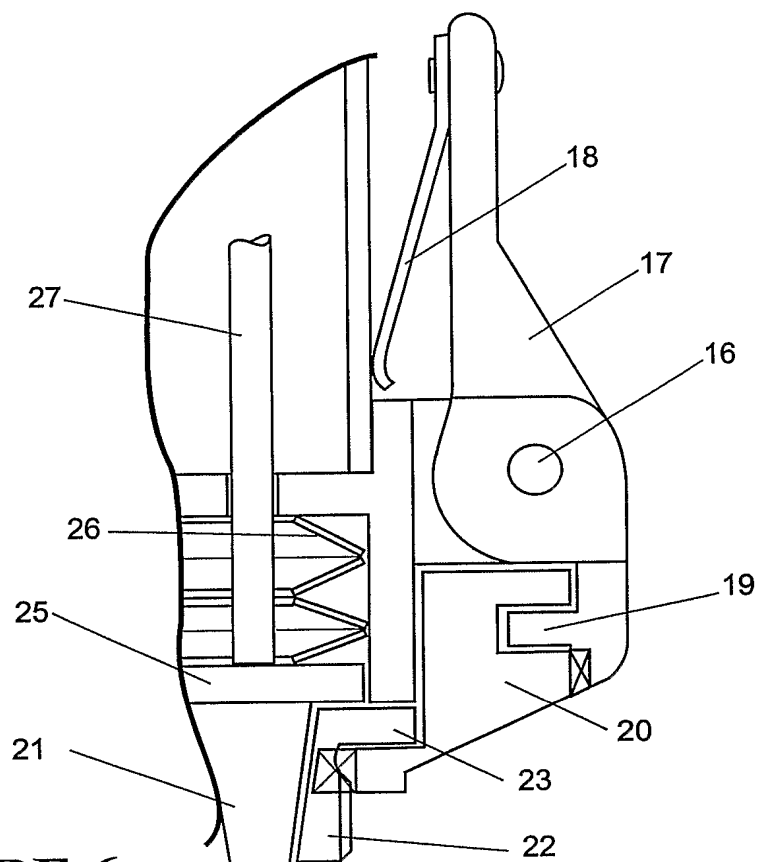


FIGURE 6

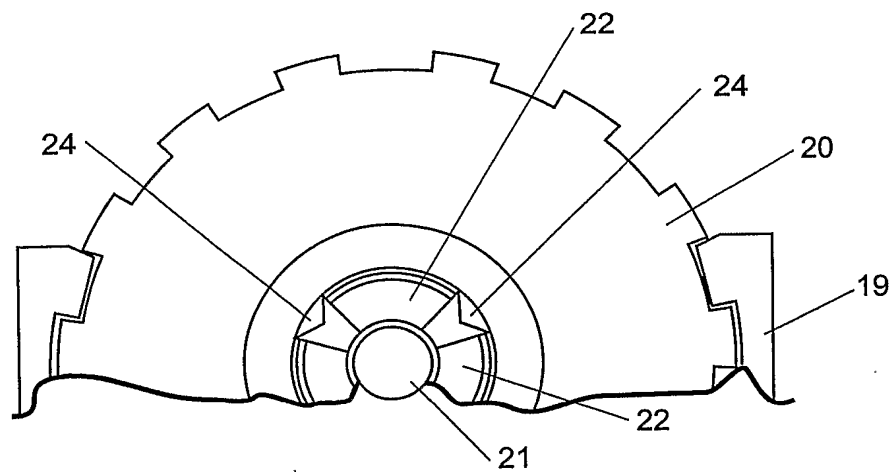


FIGURE 7

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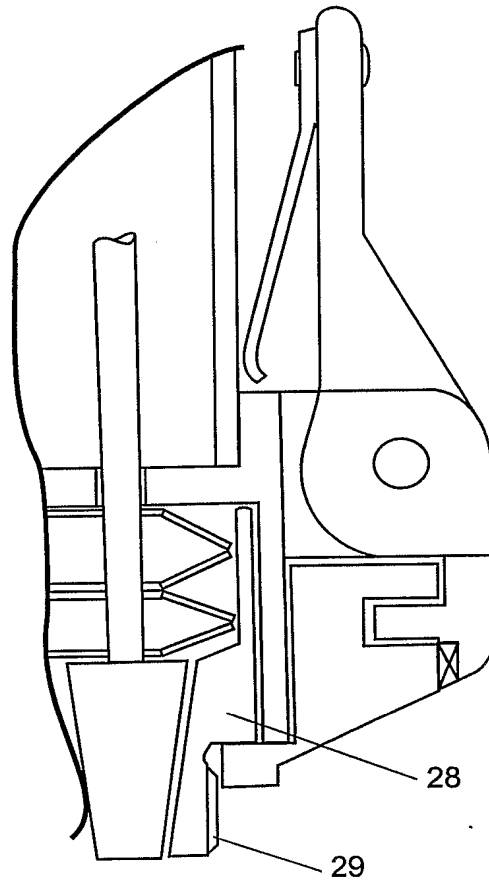


FIGURE 8

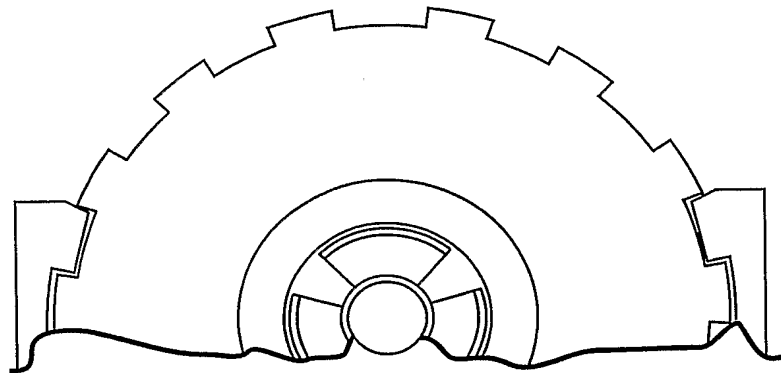
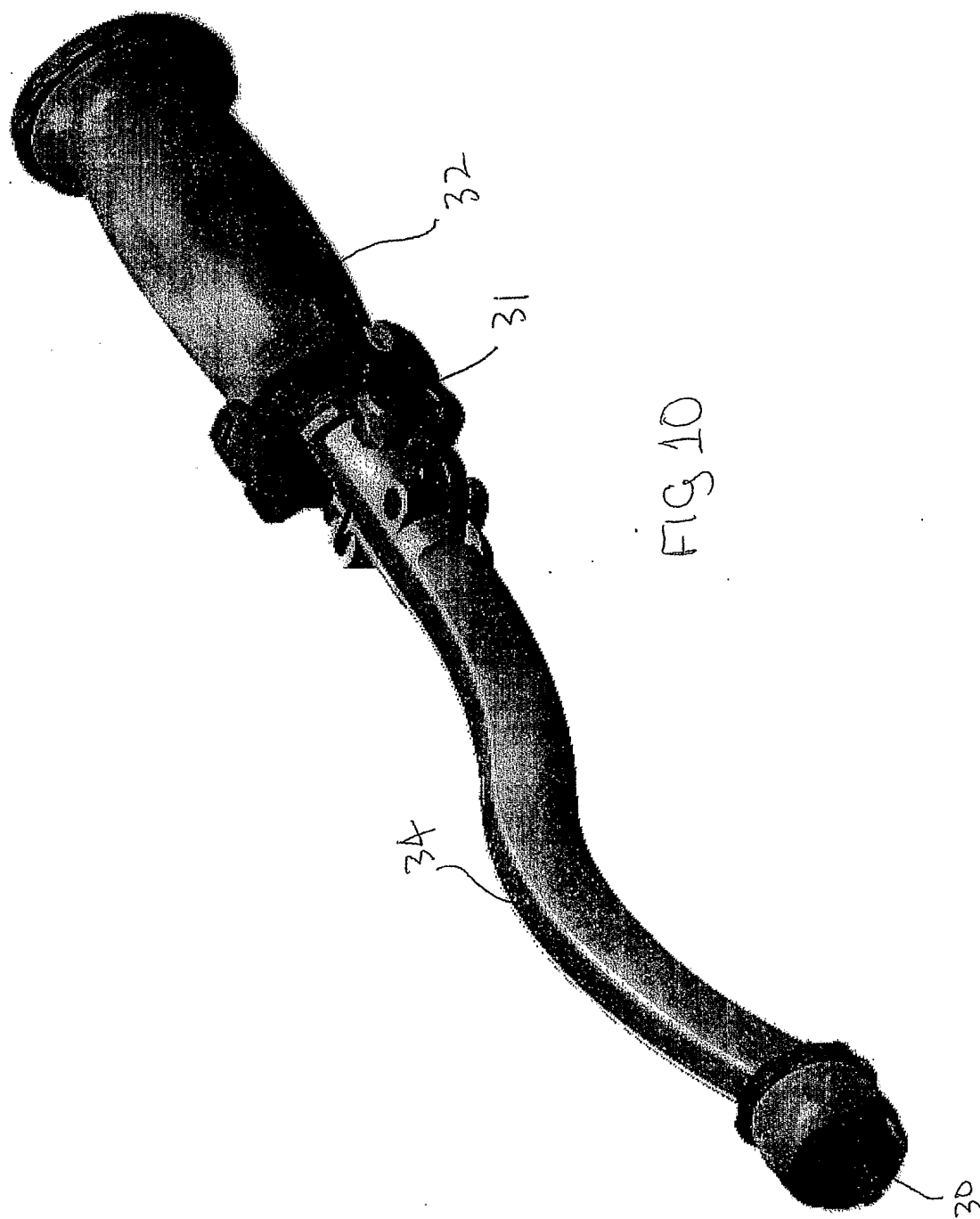


FIGURE 9

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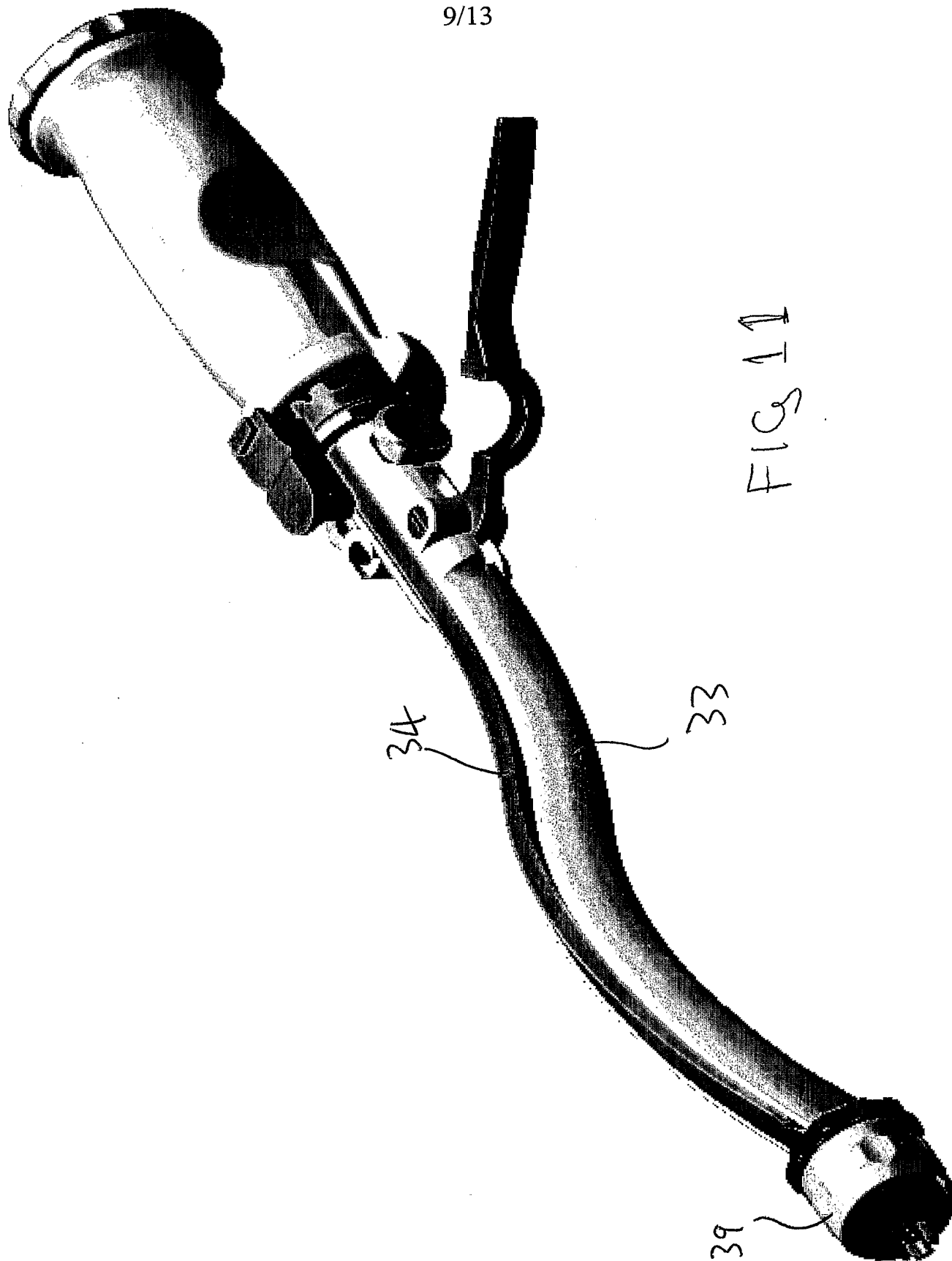
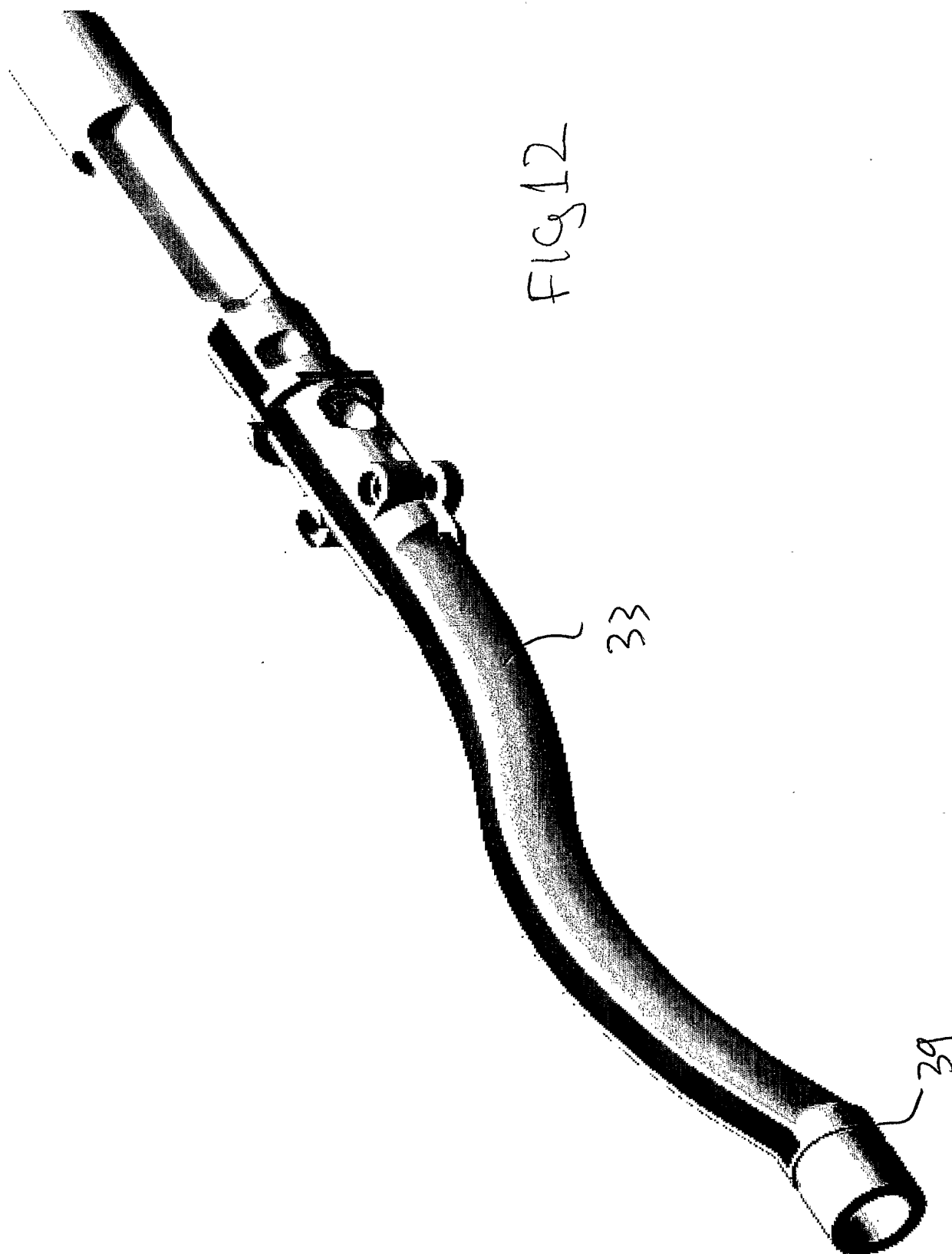
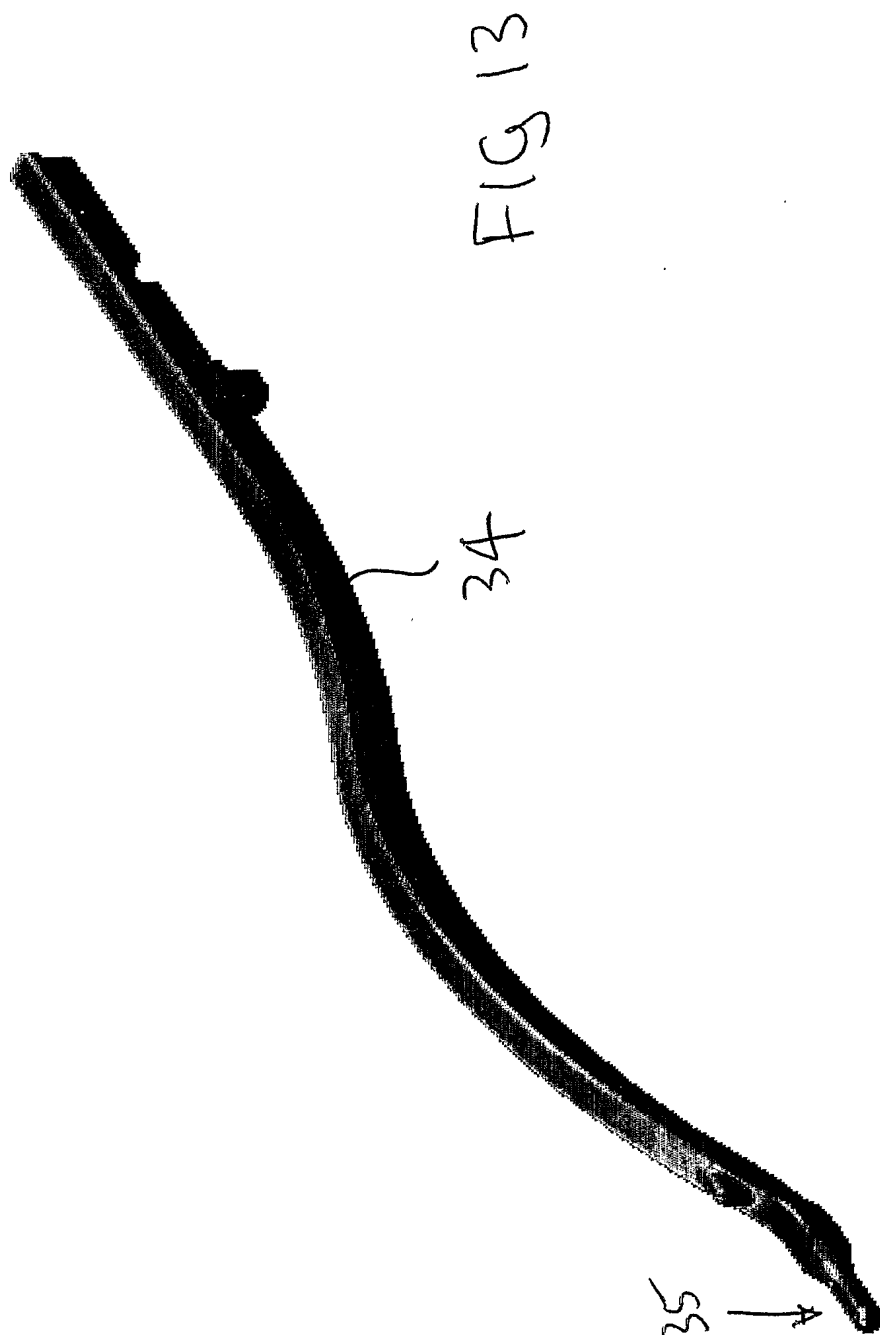


FIG 11

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FIG 14

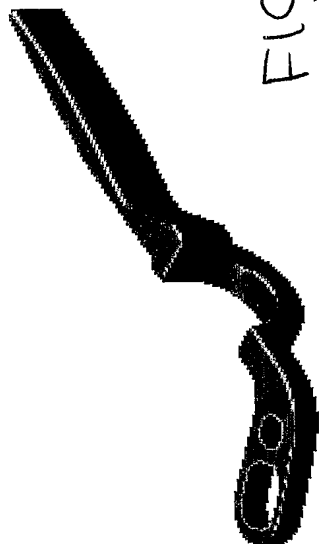


FIG 15



FIG 16



FIG 17

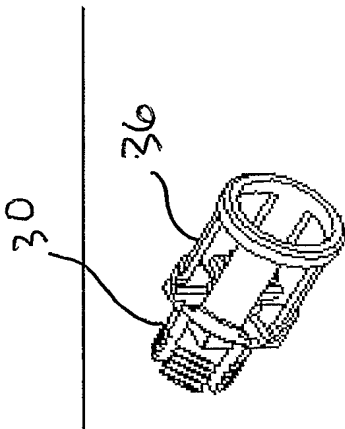


FIG 17A

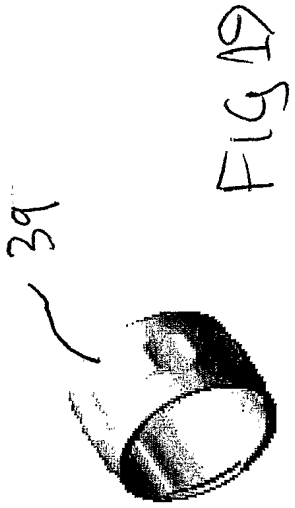


FIG 19

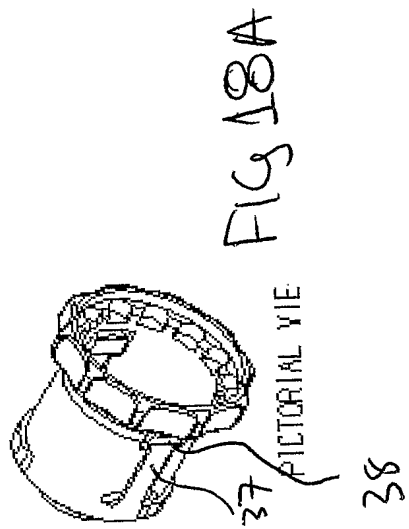


FIG 18A



FIG 18

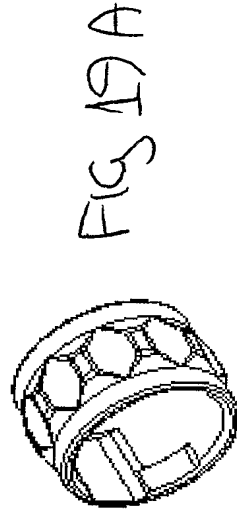


FIG 19A

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ03/00163

A. CLASSIFICATION OF SUBJECT MATTERInt. Cl. ⁷: A61B 17/92 A61F 2/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

SEE ELECTRONIC DATABASES CONSULTED

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

AU IPC: A61B 17/88, 17/92 A61F 2/46

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI: A61B A61F collet chuck jaw collar head clamp clasp bezel ring band finger prong splay expand contract enlarge open unfold segment thread screw cable lever spring rod shank hip knee bone osteo orthopaed femur tibia joint osseous acetabular arthroplas

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5116339 A (GLOCK) 26 May 1992 Column 4 lines 37 to 50, column 5 line 15 to column 6 line 31, column 6 line 38 to column 7 line 15, figures 2 and 3.	1, 6-19, 21, 22
X	US 5476467 A (BENOIST) 19 December 1995 Column 2 line 46 to column 3 line 17, figures 3 to 7	1, 2, 6, 7, 9-11, 16, 17, 22
X	US 5540697 A (REHMANN et al) 30 July 1996 Column 5 line 9 to column 6 line 26, figures 2 and 3	1, 6, 13-19, 21-22

☒ Further documents are listed in the continuation of Box C☒ See patent family annex

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
23 September 2003

Date of mailing of the international search report

29 SEP 2003

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MATTHEW FORWARD

Telephone No : (02) 6283 2606

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ03/00163

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5913860 A (SCHOLL) 22 June 1999 Column 2 lines 24 to 58	1, 7, 9, 10-17, 19, 22
X	US 5928287 A (KELLER) 27 July 1999 Column 3 line 54 to column 4 line 56, figures	1, 6, 16-19, 21-22
X	EP 1000595 A1 (SOCIETA PER AZIONI SAMO) 17 May 2000 Column 2 line 36 to column 3 line 10, figures 2, 4 and 5	1, 6, 7, 9-19, 21-22

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/NZ03/00163

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
US	5116339	NO	FAMILY		
US	5476467	NO	FAMILY		
US	5540697	NO	FAMILY		
US	5913860	EP	1058521	WO	99/43266
US	5928287	EP	861058	WO	97/42915
EP	1000595	IT	1304410	END OF ANNEX	